My Summer at Fermilab

Beam Diagnostics for Medium Energy Electron Cooling

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Electron Cooling

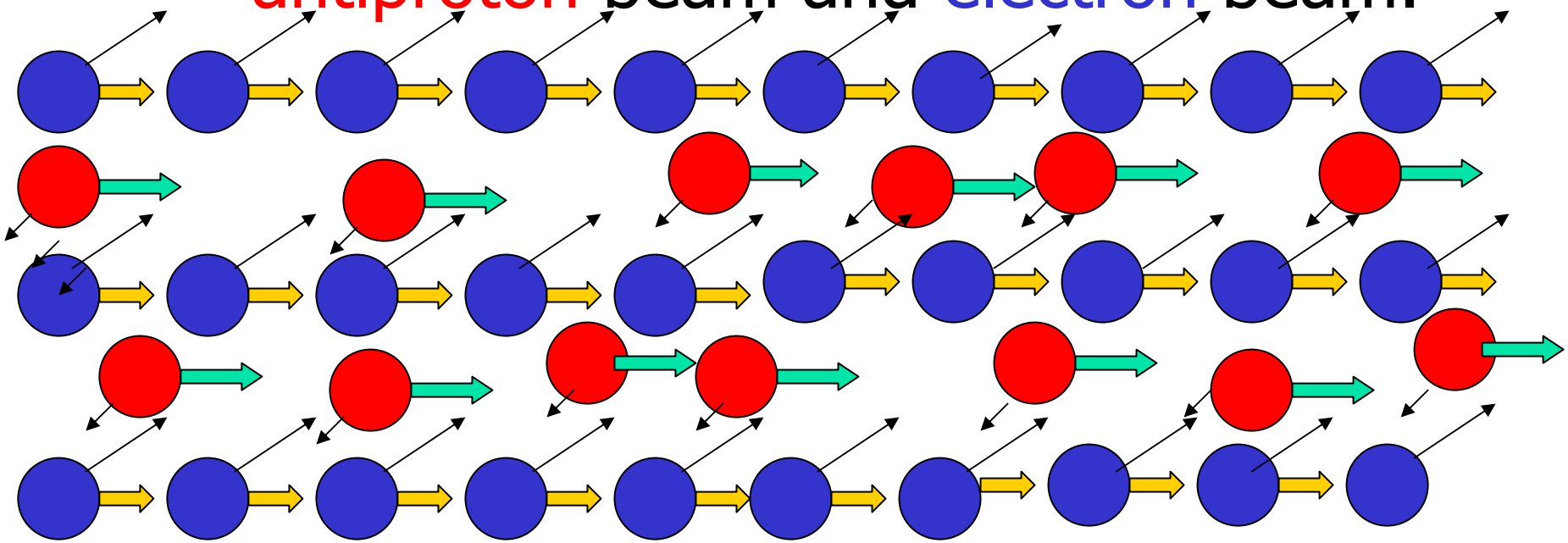
- Description of process
- Design of experiment
- Hardware
  - Solenoid
  - BPM
  - Flying wire
  - Scraper
  - Module

Why?…What?….. and How?...

- Electron cooling is needed because it improves particle beam emitance and momentum spread.
- It is a process in which a force is introduced via coulomb interactions.
- It requires 0.5 A of cold electron beam.
- Beam Energy of 4.3 MeV.
- Vacuum of 1e-^{10} torr.

Process

- Interactions between circulating antiproton beam and electron beam.

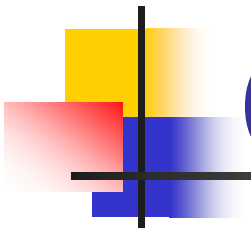


Pelletron

- 5 MV electrostatic accelerator.
- Source of electron beam.
- Pressurized with 80 psi of SF6.

Cooling Section

- Twenty meters in length.
- Composed of 10 two-meter solenoids.
- Operational magnetic field of each solenoid is between 50G to 150G.



(BPMs) Beam Position Monitors

Used for measuring beam position of both the electron and the antiproton beams.

There are 20 pairs of BPMs in the cooling system.

The required relative resolution between antiprotons and electrons is 50 microns at 1 hertz bandwidth.

Flying Wire

- Used in the Pelletron to measure beam profile.

Proportional-Integral-Derivative

- Used for positional control and motion feedback of flying wire.
- Maintains output at set level
- Changes output from set level to set point level.
- Active feedback of motion control uses an optical encoder for motion position.

Scrapers

- Allow precise beam size measurements of the electron beam.
- They are motor controlled at 400 steps/revolution.

Module

- Built in order to interface the motor wiring of the control system.
- Combination of ribbon connectors and a dv 25 cable.

Status

- The control system for scraper motion has been built and installed during the summer.
- Scraper test with electron beam is scheduled for late September.
- Flying wire measurements of the beam profile agree with theoretical predictions.
- Full diagnostic package will be ready by early fall.